ACCURATE LITERAL TRANSLATION OF PCT INTERNATIONAL APPLICATION PCT/DE2004/002634 AS FILED ON 27 NOVEMBER 2004

Turbomachine, Especially a Gas Turbine

The invention relates to a turbomachine or turbo-engine, particularly a gas turbine, according to the preamble of patent claim 1. The invention further relates to a mounting device for a turbo-engine.

Turbo-engines, for example gas turbines, comprise a rotor and a stator, whereby the rotor comprises rotor blades that rotate with the rotor and the stator comprises a housing and guide vanes. The rotor blades of the rotor rotate relative to the stationary housing and relative to the stationary guide vanes of the stator. The guide vanes form guide vane rings and the rotor blades form rotor blade rings, whereby respectively one rotor blade ring is arranged between two guide vane rings arranged one behind the other in the throughflow direction. The guide vane rings border with a radially outwardly positioned end, particularly with an outer cover band or belt, on the housing and with a radially inwardly positioned end, particularly with an inner cover band or belt, on the rotor. The guide vane rings must be secured to the housing of the turbo-engine and spoke centered relative to the housing.

German Patent Publication DE 198 07 247 A1 discloses such a turbo-engine whereby bearing journal pins are provided for the

centering and fixing of the guide vane rings. According to the German Patent Publication DE 198 07 247 A1 the bearing journal pins fixed to the housing pass through the housing of the turbo-engine and engage into bearing bushings arranged in the guide vane rings for the spoke centering of the guide vane rings. Thereby the guide pins pass through the housing of the turbo-engine in a radial direction. Thus, a longitudinal central axis of the bearing bushings extends parallel to the radial direction of the turbo-engine, whereby the corresponding bearing bushings also are oriented in the radial direction of the turbo-engine. According to German Patent Publication DE 198 07 247 A1, seal carriers are positioned between two neighboring guide vane rings, whereby the seal carriers are hooked into or suspended from the outer cover bands or belts of the guide vane rings.

Starting from the above, the problem to be solved according to the invention is to provide a new turbo-engine.

This problem is solved in that a turbo-engine mentioned above is further developed by the characteristic features of the characterizing portion of patent claim 1. According to the invention, the guide pins extend approximately perpendicularly to the housing whereby guide pin ends extending into the housing engage fork-shaped elements allocated to the radially outwardly positioned ends of the guide vane rings. The guide pins extend approximately perpendicularly to the housing and at a slant

relative to the radial direction and relative to the axial direction of the turbo-engine.

According to an advantageous further embodiment of the invention, the guide vane rings as well as the seal carriers are spoke centered with the aid of the guide pins and/or the fork-shaped elements. Each fork-shaped element preferably limits (defines) at least two recesses or receptacle spaces, whereby the guide pins engage in a first recess and whereby projections of the seal carriers engage in a second recess. The two recesses of the fork-shaped elements are positioned next to each other in the circumferential direction.

In the sense of the present invention it is suggested that the guide pins for the spoke centering of the guide vane rings are oriented perpendicularly to the housing of the turbo-engine. Thus, the guide pins do not extend in the radial direction of the turbo-engine but rather, on the one hand, at a slant to the radial direction and, on the other hand, at a slant to the axial direction of the turbo-engine. Guide pin ends reaching into the housing thus also extend at a slant to the axial direction and to the radial direction of the turbo-engine and cooperate with the fork-shaped elements in the area of the guide vane rings. In this context the fork-shaped elements are constructed to be at least partially open in the radial direction and in the axial direction of the turbo-engine in order to make possible the engagement of the fork-shaped elements with the guide pin ends reaching into the housing.

A simpler realization of the turbine-engine housing is possible with the aid of the construction according to the invention, because radially extending guide sleeves for the bearing journal pins or for guide pins can be obviated in the housing. This feature permits a clearly simpler construction of the housing and thus reduces the production costs of the turbo-engine.

The mounting device according to the invention is defined in patent claim 13.

Preferred further embodiments of the invention are defined by the dependent claims and the following specification.

An example embodiment of the invention, without limitation thereto, will now be described in more detail with reference to the drawing. The drawing shows:

Fig. 1 a partial axial section through a gas turbine according to the invention;

Fig. 2 is a substantially schematized detail of the arrangement of Fig. 1 in the area of an outer cover band or belt of a guide vane grid and an "outer air-seal" sealing in a perspective view; and

Fig. 3 shows a mounting device for the gas turbine according to the invention.

The present invention will now be described in greater detail with reference to Figs. 1 to 3. Before referring to the details of the preferred example embodiments, it should be mentioned that the present invention is suitable generally for all turbo-engines or turbo-engines with a rotor and a stator. The invention is particularly suitable for use in a compressor or a turbine of a gas turbine particularly an aircraft engine. With regard to thermodynamic and dimensional considerations the present invention is preferably used in connection with low pressure turbines of medium size to large gas turbines. Thus, Fig. 1 shows a portion of an axial longitudinal section through a low pressure turbine.

Fig. 1 shows a section view of a low pressure turbine 10 in the area of two guide vane rings 11 and 12 as well as two rotor blade rings 13 and 14. The guide vane rings 11 and 12 and the rotor blade rings 13 and 14 are positioned in the axial direction of the low pressure turbine 10 alternately one behind the other. The axial direction of the low pressure turbine 10 is shown in Fig. 1 by an arrow 15, and the radial direction thereof is shown by an arrow 16.

Each of the guide vane rings 11 and 12 is formed by several guide vanes 17 arranged next to one another in the circumferential direction of the low pressure turbine 10. Fig. 1 only shows the radially outwardly positioned ends 18 of the guide vanes 17. So-called outer cover bands or belts 19 are provided in the area of the radially outwardly positioned ends 18 of the guide vanes

17. The guide vane rings 11 and 12 are allocated to a stator of the low pressure turbine 10 whereby the stator also comprises a housing 20 in addition to the guide vanes 17 of the guide vane rings 11 and 12. The housing 20 and the guide vane rings 11 and 12 are constructed to be stationary whereby the rotor blade rings 13 and 14 allocated to a rotor are rotating relative to the stationary guide vane rings 11 and 12 and relative to the stationary housing 20. Each of the rotating rotor blade rings 13 and 14 is thereby formed by several rotor blades 21 arranged next to one another in the circumferential direction of the low pressure turbine 10. Here again Fig. 1 only shows the radially outwardly positioned ends of the rotor blades 21. So-called outer cover belts 23 are provided in the area of the radially outwardly positioned ends 22 of the rotor blades 21.

In accordance with the present invention the centering and fixing of the guide vane rings 11 and 12 is accomplished by bearing journal pins or guide pins 24 which extend approximately perpendicularly to the housing 20. As can be seen in Fig. 1, a longitudinal central axis 25 of the guide pins 24 extends approximately perpendicularly to the housing 20 and thus extends at a slant to the radial direction (arrow 16) and to the axial direction (arrow 15) of the low pressure turbine 10. Ends 26 of the guide pins 24 reach into the housing 20 and thereby engage fork-shaped elements 27 for centering and fixing the guide vane rings 11 and 12. The fork-shaped elements 27 are allocated to the outer cover belts 19 of the guide vanes 11 and 12. Thereby several fork-shaped elements 27 are positioned distributed around

the circumference of the outer cover belts of the guide vane rings 11 and 12. Thus, a respective guide pin 24 engages each of the fork-shaped elements 27 of a guide vane ring 11 or 12, whereby the guide pins 24, corresponding to the fork-shaped elements 27, are arranged and distributed around the circumference of the housing. For a spoke centering of a guide vane ring 11 or 12 at least three guide pins 24 are required to be distributed around the circumference of the low pressure turbine 10. These guide pins 24 cooperate with respective fork-shaped elements 27 in the area of the outer cover belts 19 of the guide vane rings 11 and 12. Preferably, seven such pairs of guide pins 24 and fork-shaped elements 27 are distributed and arranged about the circumference of the low pressure turbine 10 for each guide vane ring 11 and 12.

The fork-shaped elements 27 in the area of the outer cover belts 19 of the guide vane rings 11 and 12 are at least partially open in the radial direction and in the axial direction of the low pressure turbine 10 in order to make possible an engagement of the ends 26 of the guide pins 24, reaching into the housing 20, with the fork-shaped elements 27.

In accordance with the present invention the fork-shaped elements 27 of the guide vane rings 11 and 12 together with the guide pins 24 do not only cause a fixing and centering of the guide vane rings 11 and 12 in the housing but also cause a fixing and centering of seal carriers 28 which are arranged between neighboring outer cover belts 18 of neighboring guide vane rings

11 and 12. In the illustrated example embodiment the seal carriers 28 carry seal bodies 29 constructed as honeycomb seals which cooperate with so-called seal fins 30 positioned in the area of the outer cover belts 23 of the rotor blade rings 13 and 14, thereby sealing a gap between the radially outwardly positioned ends 22 of the rotor blades 21 and the housing 20 of the low pressure turbine 10.

The seal carriers 28 engage, just as the guide pins 24, in the fork-shaped elements 27 in the area of the outer cover belts 19 of the guide vane rings 11 and 12. This feature can particularly be seen in Fig. 2. Fig. 2 shows a fork-shaped element 27 in the area of an outer cover belt 19 of a guide vane ring as well as a portion of a seal carrier 28 which forms a so-called outer "air-seal" sealing. The fork-shaped element 27 comprises two recesses 31 and 32. The two recesses 31 and 32 are partially open in the radial direction as well as in the axial direction of the low pressure turbine 10 and are arranged next to one another in the circumferential direction of the same. The guide pins 24 engage with their ends 26 into a first recess 31. For reasons of a clear illustration, the ends 26 of the guide pins 24 are not shown in Fig. 2. A projection 33 of the seal carrier 28 engages in a second recess 32. Thus, it follows directly that not only a spoke centering of the guide vane rings 11 and 12 is achieved through the fork-shaped elements 27 and the guide pins 24 cooperating with the fork-shaped elements 27, but also a spoke centering of the seal carriers 28 of the so-called outer "air-seal" sealing is also achieved.

In order to limit a movability of the guide vane rings 11 and 12 in the axial direction of the low pressure turbine 10, at least one stop, not shown, is provided, whereby the stop or each stop is preferably integrated in one of the fork-shaped elements 27. With the stop or with each stop the axial movability of the guide vane rings 11 and 12 is limited to the required minimum.

The guide pins 24 or bearing journal pins are, as mentioned above, allocated to the housing 20 of the low pressure turbine 10 and reach with their free ends 26 into the interior of the low pressure turbine 10. For this purpose bores are integrated into the housing 20, whereby these bores extend perpendicularly to the housing 20. On the outside of the housing 20, nuts 34 are allocated to the guide pins 24. When the nuts 34 are loosened, the guide pins 24 can move within the bores of the housing 20. However, when the nuts 34 are tightened, the guide pins 24 particularly their free ends 26 are fixed in their position relative to the housing 20.

Fig. 3 shows a portion of the housing 20 of the low pressure turbine 10 together with two guide pins 24 and a mounting device 35 according to the invention. The mounting device 35 serves for aligning or adjusting the guide pins 24 or rather the free ends 26 of the guide pins 24 relative to the housing 20. An alignment or adjustment of the free ends 26 of the guide pins 24 is necessary in view of the following mounting or spoke centering of the guide vane rings 11 and 12 so that the free ends 26 of the

guide pins 24 may be inserted in a precise position into the recesses 31 of the fork-shaped elements 27.

The mounting device 35 comprises a plate-shaped base body 36. At least two recesses 37 are integrated into the plate-shaped base body 36. The free ends 26 of the guide pins 26 are inserted into the recesses 37 of the plate-shaped base body 36 of the mounting device 35 for the alignment or adjustment. For this purpose, according to Fig. 3, on an inner side 38 of the housing 20, the plate-shaped base body 36 of the mounting device 35 is brought into such engagement with the free ends 26 of the guide pins 24 that the ends 26 pass through the base body 36 perpendicularly through a plane defined by the plate-shaped base body 36. The ends 26 are held against rotation in the recesses 37 of the plate-shaped base body 36.

In this position of the plate-shaped base body 36 on the inside 38 of the housing 20, the nuts 34 of the guide pins 24 can be tightened on the outside 39 of the housing 20. By tightening the nuts 34 it is assured that the alignment of the free ends 26 of the guide pins 24 cannot change itself.

Following the tightening of the nuts 34 and thus following the alignment and adjustment of the guide pins 24 or rather the free ends 26 thereof, the mounting device 35 can be brought out of engagement with the free ends 26 by moving the mounting device 35 tangentially to the plane defined by the plate-shaped base body 36, out of engagement with the free ends 26 of the guide

pins. Thus, the mounting device 34 is moved in such a way that it is moved in the plane defined by the plate-shaped base body 36 whereby the free ends 26 are moved out of the recesses 37 within the plate-shaped base body 36. In order to make the handling of the mounting device 35 easier, it is provided with a handle 40 which extends approximately perpendicularly to the plate-shaped base body 36.

Although in the above example embodiment, the invention has been described with reference to an example of a low pressure turbine, it should be mentioned again that the invention can also be used in a compressor of a gas turbine. The invention is preferably used in aircraft engines.